Comparison of Sensory Profile Scores of Young Children With and Without Autism Spectrum Disorders

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Key Words: child development disorders, pervasive • pediatric occupational therapy • sensory integration

Objectives. The purpose of this study was to describe the sensory-based behaviors of young children with autism as reported by their parents on the Sensory Profile. Factor scores of children with autism were compared with those of children without autism.

Method. The Sensory Profile questionnaire was completed by parents of 40 children with autism 3 through 6 years of age and parents of 40 children without autism 3 through 6 years of age.

Results. The performance of children with autism was significantly different from that of children without autism on 8 of 10 factors. Factors where differences were found included Sensory Seeking, Emotionally Reactive, Low Endurance/Tone, Oral Sensitivity, Inattention/Distractibility, Poor Registration, Fine Motor/Perceptual, and Other.

Conclusion. Findings from the study suggest that young children with autism have deficits in a variety of sensory processing abilities as measured by the Sensory Profile. Further research is needed to replicate these findings, to examine the possibility of subgroups on the basis of sensory processing, and to contrast the sensory processing abilities of children with other disabilities to those of children with autism.


The ability to respond to sensation with appropriate physical and emotional responses depends on effective integration of perceptual and sensorimotor information. Piaget (1952) described perceptual development in early childhood as a series of stages, each of which creates a foundation for the next. Ayres (1972) described the process of sensory integration as “the organization of sensation for use” (p. 1), stating that integration of sensory information was necessary for a child to interact effectively with his or her world. Children who do not acquire developmentally mature perceptual and sensory integrative abilities often display maladaptive emotional and physical responses to environmental stimuli (Ayres, 1979; DeGangi, 1991; Murray & Anzalone, 1991; Williamson & Anzalone, 1997).

Sensory and perceptual abnormalities are common in persons with autism. Based on review of research, firsthand reports, and clinical accounts, between 30% and 100% of children with autism spectrum disorders are believed to have sensory-perceptual abnormalities of some kind (Dawson & Watling, 2000). Among these are tactile defensiveness (Grandin, 1995; McKean, 1994), auditory hyper-
sensory (Grandin, 1992; Williams, 1994), olfactory hypersensitivity (Stehli, 1991), and sensory overload (Williams, 1994). Hyporeactivity and hyperreactivity to sensory stimuli (Wing & Wing, 1971), inappropriate responses to multiple sensory stimuli (Goldfarb, 1961; Hermelin & O’Connor, 1970; Lovaas, Schreibman, Koege, & Rehm, 1971), and faulty modulation of sensory input (Ornitz, 1974) are also described.

Abnormal responses to sensory stimulation may differentiate young children with autism from children with typical development and children with mental retardation. For example, Dahlgren and Gillberg (1989) found that sensitivity to auditory stimuli in infancy was a powerful discriminator between children with and without autism (N = 26). Mayes and Calhoun (1999) examined diagnostic criteria for autism and found that 100% of their sample (N = 24) exhibited somatosensory characteristics and suggested that this element should be included as part of the diagnostic criteria. More recently, Baranek (1999) found significant differences in the sensorimotor behaviors of infants 9 months to 12 months of age in her group comparison study of children with autism, children with mental retardation, and children with typical development. These studies provide evidence that sensory-perceptual abnormalities are prevalent among young children with autism. Much of the research in this area, however, is methodologically weak, and more data are needed to determine the prevalence, nature, and characteristics of the sensory-perceptual deficits that persons with autism spectrum disorders experience.

Occupational therapists frequently measure sensory processing in their comprehensive assessments because faulty processing can have a negative impact on the performance of daily life activities (DeGangi, 1991; Dunn, 1997; Murray & Anzalone, 1991; Williamson & Anzalone, 1997). Current methods of assessment typically consist of clinical observations, informal questionnaires, and parent interviews. These approaches lack standardization and the normative data necessary for establishing consistent interpretation of sensory processing abilities. The Sensory Profile (Dunn, 1999), a 125-item parent-report questionnaire, is the first available sensory processing assessment for which normative data have been reported.

To date, two studies using the Sensory Profile with children with autism have been reported in the literature. In a preliminary study (N = 32) using a pilot version of the Sensory Profile, Kientz and Dunn (1997) found that 3-year-old to 13-year-old children with autism performed differently (p < .000) from 3-year-old to 10-year-old children with typical development. A univariate analysis revealed that 84 of the 99 items on the pilot version accounted for the differences between the groups in this study; however, no specific items on the Sensory Profile were considered common for children with autism. In a subsequent study, Ermer and Dunn (1998) identified 46 items and 4 factors from the Sensory Profile that discriminated among children with autism spectrum disorders (n = 38), children with attention deficit hyperactivity disorder (n = 61), and children without disabilities (n = 1,075). The 4 factors were Sensory Seeking, Oral-Motor, Inattention/Distractibility, and Fine Motor/Perceptual. The authors concluded that the Sensory Profile was an effective tool for discriminating between children in these three groups and that children with autism displayed a specific pattern of sensory responses that was identified by the Sensory Profile.

The studies by Kientz and Dunn (1997) and Ermer and Dunn (1998) provide an excellent beginning in examining the sensory processing differences between children with and without autism. Additional research is necessary to continue developing knowledge in this area. Given the possibility that sensory processing abilities may vary at different ages or stages of development, the next step in this line of inquiry is to examine the sensory processing abilities of children with and without autism within distinct age groups. The present study sought to describe the Sensory Profile factor scores of 3-year-old through 6-year-old children with and without autism and to compare the factor score patterns of the two groups. The following research questions were addressed:

1. Do significant differences exist between the scores of children with autism or pervasive developmental delay and children who are typically developing on those Sensory Profile factors representing areas of sensory processing described in the literature as frequently deficient in persons with autism (i.e., Sensory Seeking, Emotionally Reactive, Oral Sensitivity, Inattention/Distractibility, Poor Registration, Sensory Sensitivity)?

2. Can patterns of sensory-based behaviors be identified in the Sensory Profile factor scores of young children with autism?

Method
Sample
A group comparison design was used to describe sensory-based behaviors of 40 children with autism spectrum disorders and 40 children without any known disabilities. (The sample included children with autism or pervasive developmental delay. To minimize cumbersome sentences, the text refers to “children with autism.”) Parents of two groups of children between 36 months and 83 months of age (3 years, 0 months and 6 years, 11 months) participated. Each child with autism was matched to a child without disabilities on the variables of age and gender. The study design also sought to match children on ethnicity; however, all children in the study were Caucasian. Three children with autism who initially were recruited for the study were eliminated during the screening process because of an inability to find appropriately matched children without...
disabilities. The parents of two children without disabilities who began the study did not complete all steps (i.e., did not return consent form or complete the demographic interview), and the children were replaced in the final sample. Age categories were established in 6-month increments from 3 years through 6 years, 11 months. The mean age differences between the two groups were less than 1 month for all age categories under 6.5 years. For the 6.6 year to 6.11 year category, the mean age difference was 1.4 months. Compared with prevalence data identifying a gender ratio for autism of 4 boys to 1 girl (Bryson, 1996), the gender distribution of participants in the present study was 7 boys to 1 girl. Inclusion criteria for children with autism were (a) age within the specified range and (b) diagnosis of an autism spectrum disorder (e.g., autism, pervasive developmental delay). Inclusion criteria for the comparison group were (a) age within the specified range, (b) absence of a diagnosed medical condition that might compromise development (e.g., attention deficit hyperactivity disorder, Down syndrome, cerebral palsy), and (c) no siblings with an autism spectrum disorder.

Parents of children with and without autism spectrum disorders were recruited from three sites representing both urban and suburban communities: a diagnostic center, a hospital-based therapy clinic, and a public preschool. At the diagnostic center, the occupational therapist who had participated on the diagnostic team contacted parents by telephone. The therapist explained the study and then mailed a cover letter and consent form to those parents interested in participating. The study questionnaire was mailed to the parent when the researchers received the completed consent form. At the therapy clinic, therapists working with children with autism described the study to parents and distributed the consent form. On receipt of the completed consent form, the therapist distributed the study questionnaire. At the school, teachers distributed the cover letter and consent forms to parents by placing a packet in each child’s backpack. The study questionnaire was distributed via the child’s backpack after the parent returned a completed consent form to the school. All forms were coded numerically to allow for tracking while maintaining confidentiality.

Instrument

The research version of the Sensory Profile (Dunn & Westman, 1995) was used in this study. The 125 items and 10 factors included in this version are identical to the published questionnaire (Dunn, 1999), except for grammatical changes in item wording. The 10 Sensory Profile factors are Sensory Seeking, Emotionally Reactive, Low Endurance/Tone, Oral Sensitivity, Inattentiveness/Distractibility, Poor Registration, Sensory Sensitivity, Sedentary, Fine Motor/Perceptual, and Other. To complete the Sensory Profile, parents used a 5-point Likert scale ranging from always to never to record the frequency with which their child displayed each behavior. Each parent completed the questionnaire independently. The primary investigator was available by telephone to answer questions. The primary investigator contacted each parent by telephone 1 week after the parent received the Sensory Profile to answer questions related to the questionnaire or study procedures and to gather demographic data.

Data Analysis

The completed Sensory Profile questionnaires were scored according to guidelines presented at the 1996 American Occupational Therapy Association Annual Conference (Ermer & Dunn, 1996) and later published in the Sensory Profile User’s Manual (Dunn, 1999). Each parental response was converted to a numerical value corresponding to the frequency of each behavior (i.e., 1 = always, 5 = never). Using this conversion, behaviors that occur frequently receive low scores. The Sensory Profile items are written such that frequent behaviors are undesirable. For example, a child who received a 1 for “twirls/spins self frequently throughout the day,” would, according to parent report, always demonstrate this behavior, whereas a child who received a 5 on this item would never display the behavior. Thus, low scores are undesirable because they suggest that a child has sensory processing difficulties, and high scores are desirable because they suggest appropriate responses to sensory stimuli.

Factor scores were calculated by converting parent responses to numerical values, entering item scores onto the factor grid (Dunn, 1996), and calculating the sum for each factor. The data were analyzed with Microsoft Excel 97 (Microsoft Corporation, 1997), Data Desk 6.0 (Data Description, 1997), and the Statistical Package for the Social Sciences 9.0.0 for Windows (SPSS, 1998). Because the primary research question involved multiple comparisons, 1 for each of the 10 factors, the probability of making a Type I error was increased. Therefore, the alpha level was set at $p \leq .005$ (two-tailed), using Bonferroni’s adjustment whereby the desired alpha level (in this case, $p = .05$) is divided by the number of comparisons (Godfrey, 1985).

Results

Of the 40 children with autism in this study, 39 attended public preschool or kindergarten programs, and 1 did not attend school. Of the 39, 30 were in inclusive classrooms and 9 in self-contained classrooms. Thirty-six of the children without autism attended school (27 public, 9 private), and 4 did not attend school. Twelve children with autism received speech–language therapy at school; 4 received private services; and 18 received both. Nine children with autism received school-based occupational therapy services; 7 received private services; and 18 received both. Ten children with autism were taking medication at the time of the
study. Though three of the children without autism had received speech–language therapy before the time of the study, none of them were receiving special services or taking medication at the time of the study.

Parents of children in both groups reported a similar occurrence of family history of disability. Family history was considered positive if (a) the child's parent, aunt, uncle, cousin, or grandparent had autism, learning disability, or attention deficit disorder or (b) a sibling of the child had attention deficit disorder, learning disability, or developmental delay. Twelve children with autism and 10 without autism met the criteria for a positive family history of disability. Three families in each group reported that they did not know their family histories.

Developmental information was gathered from parent report to determine group differences in achievement of general milestones. Children in both groups achieved motor milestones at similar ages, with a mean difference of .4 months for age of sitting and a mean difference of .2 months for age of walking. However, substantial group differences occurred in toilet training. At the time of data collection, only 20 (50%) of the children with autism had achieved independent toileting. By contrast, 36 (90%) of the children without autism had mastered the skill.

The Sensory Profile scores between the groups were compared by examining the performance of each group on each factor. Figure 1 presents bar graphs for each group's factor scores. The graphs indicate the lowest and highest scores received as well as the number of children from each group receiving a score in the designated range. On the Emotionally Reactive factor, 67.5% of the children with autism displayed more frequent sensory behaviors than any of the children without autism. On the Low Endurance/Tone factor, children with autism received scores across a broad range, whereas 77.5% of the children without autism clustered at the highest end of the scale. On the Poor Registration factor, 62.5% of the children without autism scored higher than any of the children with autism. On the Other factor, 65% of the children with autism had scores lower than any of the children without autism.

Table 1 displays the descriptive statistics and findings related to the first research question: Do significant differences exist between children with and without autism in Sensory Profile factor scores? As a group, young children with autism tended to have lower scores than children without autism. In addition, the scores of children with autism were more widely distributed across the possible range of scores. Score differences between the groups were significant on 8 of the 10 factors, with no significant differences found for the Sensory Sensitivity and Sedentary factors.

Further analyses were conducted to answer the second research question, “Can patterns be identified in the Sensory Profile factor scores of children with autism?” Twenty-seven children with autism received lower scores than the children without autism on the Emotionally Reactive factor, and 26 received lower scores on the Other factor. Many children with autism (n = 16) had scores lower than the children with typical development on the Poor Registration factor. In most cases, these children also had lower scores on either the Emotionally Reactive factor, Other factor, or both. Further, we determined the number of factors on which each child with autism had scores lower than those of the children without autism. For children with autism, this number ranged from 0 to 6 factors, with 34 (85%) children receiving scores lower than any of the children without autism on at least 1 factor. Of those 34, 6 had scores lower than any child without autism on 1 factor, 11 on 2 factors, 5 on 3 factors, 6 on 4 factors, 4 on 5 factors, and 2 on 6 factors.

Discussion

The major finding from this study is that the scores of children with autism were significantly different from those of children without autism on 8 Sensory Profile factors: Sensory Seeking, Emotionally Reactive, Low Endurance/Tone, Oral Sensitivity, Inattention/Distractibility, Poor Registration, Fine Motor/Perceptual, and Other. This finding is consistent with the literature that describes hyposensitivities and hypersensitivities to sensory stimuli (Poor Registration factor), sensitivities to auditory and visual stimuli (Sensory Sensitivity factor), picky eating habits (Oral Sensitivity factor), poor attention and play skills (Inattention/Distractibility factor), poor coping and variability in emotional responses (Emotional Reactivity factor), hyperactivity (Sensory Seeking factor), and a variety of other abnormal perceptual responses (Other factor) among children with autism or pervasive developmental delays (see Baranek, Foster, & Berkson, 1997; O'Neil & Jones, 1997; Wing & Wing, 1971). The significant differences in Sensory Profile factor scores of 3-year-old through 6-year-old children with and without autism strengthens the argument that sensory processing is an important area of difference between these groups. This finding also supports using the Sensory Profile to identify the sensory processing tendencies of these age groups.

As a group, the children with autism also had scores that tended to spread further across the possible score ranges than the scores of the children without autism, suggesting that this group may not be homogenous. This wide spread of scores is evident in the distributions on the Low Endurance/Tone, Oral Sensitivity, Sensory Sensitivity, and Fine Motor/Perceptual factors (see Figure 1). This finding suggests that although many children with autism may have compromised sensory processing, the sensory processing of some children with autism may be similar to that of children without autism. This inconsistency highlights the individuality of each child and reminds therapists that a specific child may or may not exhibit differences from the
Figure 1. Distribution of scores for children with autism (n = 40) and children without autism (n = 40) for each Sensory Profile factor. Low scores are undesirable and represent more frequent demonstration of the behaviors; high scores are desirable and represent infrequent demonstration of the behaviors. Note. * = scale of y axis is 40 on the Low Endurance/Tone graph.
group to which he or she belongs. Therefore, clinicians must remain objective when assessing a young child with autism and conduct a thorough evaluation of sensory processing abilities to determine whether that child's sensory processing is compromised.

Another important finding was the way in which patterns of low scores for the group of children with autism were distributed across the Sensory Profile factors. A majority of these children scored lower than any child without autism on the Emotionally Reactive (n = 27) and Other (n = 26) factors. A large number of children with autism (n = 16) also had scores lower than any child without autism on the Poor Registration factor. This cluster of low scores for a majority of children with autism suggests the possibility that taken together, these 3 factors may be helpful in discriminating between children with and without autism in the 3-year-old through 6-year-old age range.

The finding that children with autism scored lower (more frequent behaviors) than children without autism on the Sensory Seeking and Emotionally Reactive factors is interesting, though not unexpected, given that these 2 factors have good face validity for being sensory-based measures and that the items included on these factors are similar to the sensory-based behaviors frequently described in the literature. However, this finding contrasts that of Ermer and Dunn (1998) who reported a lower incidence of the behaviors on the Sensory Seeking factor for children with autism. This difference in the data gathered from two different samples highlights the importance of conducting multiple studies in an effort to replicate the findings of an initial study. Further, clinicians must exercise caution when interpreting scores on the Sensory Profile only on the basis of preliminary findings. Further research is needed to determine whether any of the Sensory Profile factors will be helpful in discriminating between young children with and without autism on the basis of sensory processing abilities. Even so, the finding that 85% of the children with autism scored lower than any of the children without autism on at least 1 factor suggests that clinicians should conduct further assessments of any child from 3 through 6 years of age who obtains 1 or more Sensory Profile factor scores that are lower than those of the children without autism in this study. (See Table 1 for the low and high factor scores of each group.)

The low score patterns of children with autism were investigated in an effort to identify potential subgroups. Eight children with autism had scores lower than any child without autism on the Oral Sensitivity, Emotionally Reactive, and Other factors. In a similar pattern, 7 children with autism had scores lower than any child without autism on the Poor Registration factor. This cluster of low scores for a majority of children with autism suggests the possibility that taken together, these 3 factors may be helpful in discriminating between children with and without autism in the 3-year-old through 6-year-old age range.

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Table 1
Factor Scores for Children With and Without Autism

<table>
<thead>
<tr>
<th>Factor</th>
<th>Floor</th>
<th>Ceiling</th>
<th>M</th>
<th>Median</th>
<th>SD</th>
<th>Low/High</th>
<th>Mann Whitney U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory Seeking</td>
<td>17</td>
<td>85</td>
<td>52.6</td>
<td>51.5</td>
<td>11.9</td>
<td>25/73</td>
<td>p &lt; .0001</td>
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<td>Autism</td>
<td>68.7</td>
<td>70.5</td>
<td>9.8</td>
<td></td>
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<td>Emotionally Reactive</td>
<td>16</td>
<td>80</td>
<td>45.6</td>
<td>46.0</td>
<td>8.7</td>
<td>23/65</td>
<td>p &lt; .0001</td>
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<td>63.7</td>
<td>63.5</td>
<td>7.9</td>
<td></td>
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<tr>
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<tr>
<td>Low Endurance/Tone</td>
<td>9</td>
<td>45</td>
<td>37.0</td>
<td>36.5</td>
<td>6.4</td>
<td>23/45</td>
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<td>44.0</td>
<td>2.9</td>
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<tr>
<td>Oral Sensitivity</td>
<td>9</td>
<td>45</td>
<td>26.3</td>
<td>27.0</td>
<td>8.6</td>
<td>12/44</td>
<td>p &lt; .0001</td>
</tr>
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<td>37.5</td>
<td>6.9</td>
<td></td>
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<tr>
<td>Inattention/Distractibility</td>
<td>7</td>
<td>35</td>
<td>20.4</td>
<td>21.0</td>
<td>4.2</td>
<td>11/28</td>
<td>p &lt; .0001</td>
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<td>3.8</td>
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<td>Poor Registration</td>
<td>9</td>
<td>45</td>
<td>30.6</td>
<td>30.0</td>
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<td>41.0</td>
<td>3.4</td>
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<td>Sensory Sensitivity</td>
<td>4</td>
<td>20</td>
<td>17.7</td>
<td>19.0</td>
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<td>10/20</td>
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<td>19.0</td>
<td>1.4</td>
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<tr>
<td>Sedentary</td>
<td>4</td>
<td>20</td>
<td>13.0</td>
<td>13.0</td>
<td>3.2</td>
<td>5/19</td>
<td>p = .0490</td>
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<td>2.8</td>
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<tr>
<td>Fine Motor/Perceptual</td>
<td>4</td>
<td>20</td>
<td>9.7</td>
<td>9.0</td>
<td>3.0</td>
<td>5/16</td>
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<td>13.0</td>
<td>3.4</td>
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<tr>
<td>Other</td>
<td>46</td>
<td>230</td>
<td>165.7</td>
<td>166.5</td>
<td>22.2</td>
<td>111/213</td>
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*aLowest score possible on subscale. bHighest score possible on subscale.*
Because of our small sample size, however, these findings could not be examined thoroughly. Further investigation using larger samples to determine whether such subgroups can be identified on the basis of sensory processing behaviors is necessary.

Of the 40 children with autism in this study, 6 did not have any factor scores lower than the children without autism. We conducted exploratory analyses to determine whether these children were truly different from the group. Analysis of the raw data showed that some parents of these 6 children did not provide responses at the extreme high or low ends of the Likert scale. Two possibilities explain this occurrence. First, the parents accurately reported their children's behavior, and their children's scores fell in the range of scores demonstrated by the children without autism. However, clinical observations of 2 of these 6 children suggest that the parent report did not reflect the behaviors exhibited in the clinical setting. Although the possibility exists that some children with autism do not demonstrate extreme sensory behaviors, it also is possible that the intensity of some behaviors exhibited by the children in this study were moderated by parent report. The second possible explanation for the difference in scores is that some of the parents of children with autism may have reported extreme behaviors because they expected that their children were different. These questions regarding the accuracy of parent report underscore the importance of incorporating clinical observations and professional judgment with results from parent-report questionnaires, such as the Sensory Profile.

Implications for Occupational Therapy Practice

The results of this study support the need to measure sensory processing abilities in young children with autism during occupational therapy evaluations. The Sensory Profile may be a valuable tool in accomplishing this goal. As with all parent-report measures, however, information provided on the Sensory Profile may be inconsistent with clinical observations of sensory processing. Therefore, clinicians should consistently supplement parent report with clinical observations and structured situations in which sensory processing abilities may be assessed. Clinical observations, behavior during standardized assessment, and structured play observations may be helpful.

The Sensory Profile does not provide diagnostic information, and this study did not contrast the Sensory Profile score patterns of children with autism to children in other diagnostic groups who frequently demonstrate sensory processing deficits. Further, this study did not examine the ability of the Sensory Profile to discriminate between children with and without autism. Therefore, clinicians should use caution not to assume a diagnosis when a child demonstrates a pattern of sensory behaviors similar to those identified for the children with autism in this study. Further research is necessary to determine whether the pattern of behaviors identified in this study is unique to children with autism and to determine whether Sensory Profile scores discriminate between children with and without autism spectrum disorders.

Limitations

The small sample size in this study and the fact that the sample represented only one region of the country are the primary limitations of this study. Although these may limit the generalizability of the findings, the careful matching of children in the two groups strengthened the design and increased confidence that results are relevant when using the Sensory Profile with young children with autism. Future studies could be strengthened by including mental age testing and a control group of children with developmental delays.

Conclusion

Findings from this study provide clear support for the presence of sensory processing differences between 3-year-old through 6-year-old children with and without autism. Differences were significant in behaviors related to sensory registration, sensory sensitivity, sensory seeking, emotional reactivity, oral sensitivity, distractibility, and other sensory-based behaviors. Exactly 50% of the children with autism had scores that were lower than any of the children without autism on both the Emotionally Reactive and Other factors, suggesting that these Sensory Profile factors may be especially useful in identifying sensory processing deficits in children with autism. Clinicians are cautioned, however, to use the Sensory Profile in combination with clinical observations and other measures of sensory processing abilities to ensure that a child's full range of behaviors are assessed. Additional research with larger groups is needed to fully understand the nature and prevalence of sensory processing dysfunction in children with autism.

Acknowledgments

We thank Good Samaritan Hospital Children’s Therapy Unit, Puyallup, Washington; Center on Human Development and Disability, University of Washington, Seattle, Washington; and Experimental Education Unit, University of Washington, Seattle, Washington, for their assistance in recruiting participants for this study. We also thank Sue Wendel, M.S., OTR, for her assistance in data collection.

This study was funded in part by the Maternal and Child Health Bureau, Division of Health and Human Services (Grant Title, “Leadership Education in Neurodevelopmental Disorders,” MCJ 539159-08-0) and the U.S. Department of Education (Project Title, “Preparing Leaders for Careers in Transdisciplinary Professional Development, Research, and Administration in the Education of Children with Disabilities,” H029D70035).

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